NOAA Backgrounder

NOAA and Tsunamis

A tsunami is a series of ocean waves generated by any rapid large-scale disturbance of the sea water. Most tsunamis are generated by earthquakes, but they may also be caused by volcanic eruptions, landslides, undersea slumps, or meteor impacts.

The waves radiate outward in all directions from the disturbance, and can propagate across entire ocean basins. For example, an earthquake in Chile caused a tsunami across the Pacific in Japan. Tsunami waves are distinguished from ordinary surf waves by their great length, often exceeding 100 miles in the deep ocean, and by the long amount of time between successive peaks five minutes to an hour. The speed at which tsunamis travel depends on the ocean depth. A tsunami can exceed 500 mph in the deep ocean but slows to 20 or 30 mph in the shallow water near land. In less than 24 hours, a tsunami can cross the entire Pacific Ocean.

In the deep ocean, a tsunami is barely noticeable and will only cause a small and slow rising and falling of the sea surface as it passes. Only as it approaches land does a tsunami become a hazard. As the tsunami approaches land and shallow water, the waves slow down and become compressed, causing them to grow in height. In the best of cases, the tsunami comes onshore like a quickly rising tide and causes a gentle flooding of low-lying coastal areas.

In the worst of cases, a bore will form. A bore is a wall of turbulent water that can be several meters high, and can rush onshore with great destructive power. Behind the bore is a deep and fast-moving flood that can pick up and sweep away almost anything in its path, such as what happened in Papua New Guinea in 1998 when more than 2,000 people were killed and villages destroyed. Minutes later, the water will drain away as the trough of the tsunami wave arrives, sometimes exposing great patches of the sea floor. But then the water will rush in again as before, causing additional damage.

This destructive cycle may repeat many times before the hazard finally passes. Persons caught in the path of a tsunami have little chance to survive. They can be easily crushed by debris or they may simply drown. Children and the elderly are particularly at risk, as they have less mobility, strength, and endurance.

Tsunamis typically cause the most severe damage and casualties very near their source. There the waves are

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A WORD ABOUT NOAA. . .

The National Oceanic and Atmospheric Administration (NOAA) conducts research and gathers data about the global oceans, atmosphere, space, and sun, and applies this knowledge to science and service that touch the lives of all Americans.

NOAA warns of dangerous weather, charts our seas and skies, guides our use and protection of ocean and coastal resources, and conducts research to improve our understanding and stewardship of the environment which sustains us all.

A Commerce Department agency, NOAA provides these services through five major organizations: the National Weather Service, the National Ocean Service, the National Marine Fisheries Service, the National Environmental Satellite, Data and Information Service, and Office of Oceanic and Atmospheric Research; and numerous special program units. In addition, NOAA research and operational activities are supported by the Nation's seventh uniformed service, the NOAA Corps, a commissioned officer corps of men and women who operate NOAA ships and aircraft, and serve in scientific and administrative posts.

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highest because they have not yet lost too much energy to friction or spreading. In addition, the nearby coastal population, often disoriented from the violent earthquake shaking, has little time to react before the tsunami arrives. The largest tsunamis, however, can cause destruction and casualties over a wide area, sometimes as wide as the entire Pacific basin. These types of Pacific-wide tsunamis may happen only a few times each century.

As with any natural hazard, the more informed the public is, the better are the chances for their survival. After the 1998 Papua New Guinea tsunami, a team went to Vanuatu, a group of islands in the Pacific, and showed videos of earthquakes, tsunamis, and volcanoes to the villagers. When a tsunami struck there in December 1999, three people died. According to the research laboratory team, the others remembered the lessons of the video and headed for high ground when the earth began to shake and the water began to recede.

NOAA has six tsunami buoys from the Aleutian Islands along the West Coast down to the equator that will send warning signals if they feel a shift in the seafloor. They make up the Deep-ocean Assessment and Reporting of Tsunamis (DART) project, which offers early detection of tsunamis and for assessing and forecasting the threat to coastal communities. DART also reduces false alarms that undermine the credibility of the warning system and are extremely expensive; 75% of all warnings issued since 1948 have been false, and the evacuation of Honolulu in 1986 cost more than $30 million.

The Pacific Marine Environmental Laboratory has developed a system that acoustically transmits data from a Bottom Pressure Recorder (BPR) to a surface buoy, which then sends the data to shore-based receivers through a satellite communications link. The BPR research experience over the last 10 years indicates that these real-time systems are capable of detecting deep ocean tsunamis with amplitudes as small as 1 cm. A prototype system was fabricated, tested, and successfully deployed for two months off the Washington-Oregon coast in 1995.

To see the data collected by the buoys, visit:
http://tsunami.pmel.noaa.gov/dartqc/WaveWatcher

For more information, visit the National Tsunami Hazard Mitigation Program Web site at www.pmel.noaa.gov/tsunami-hazard/ or contact Delores Clark in Honolulu, Hawaii, at (808) 532-6411; Jana Goldman in Silver Spring, Maryland at (301) 713-2483; Marilu Trainor in Salt Lake City, Utah at (801) 524-5694 ext. 226; or Ann Thomason in Seattle, Washington, at (206) 526-6800.

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